

# Landsat Data Continuity Mission On-orbit Calibration and Validation Development

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U.S. Geological Survey

# Outline

- Overview of Government Calibration and Validation Team
- Overview of Ground System
- Development of Cal/Val tools
- Current Status



August 29—September 1, 2011

CALCON Technical Conference



# Government Calibration and Validation Team (CVT)

- Made up of both NASA GSFC and USGS EROS personnel
- Lead by NASA prior to commissioning
  - Pre-launch calibration
- On-orbit operations turned over to USGS
  - Continued monitoring throughout mission life



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# Calibration and Validation Functions

- Oversight and coordination of Cal/Val activities
  - Covers portions of ground system, spacecraft, instruments and other external entities
- Algorithm development
  - Review instrument provider algorithms
  - Deliver algorithms to ground system developers
  - Data processing, characterization and calibration
  - OLI and TIRS data simulators

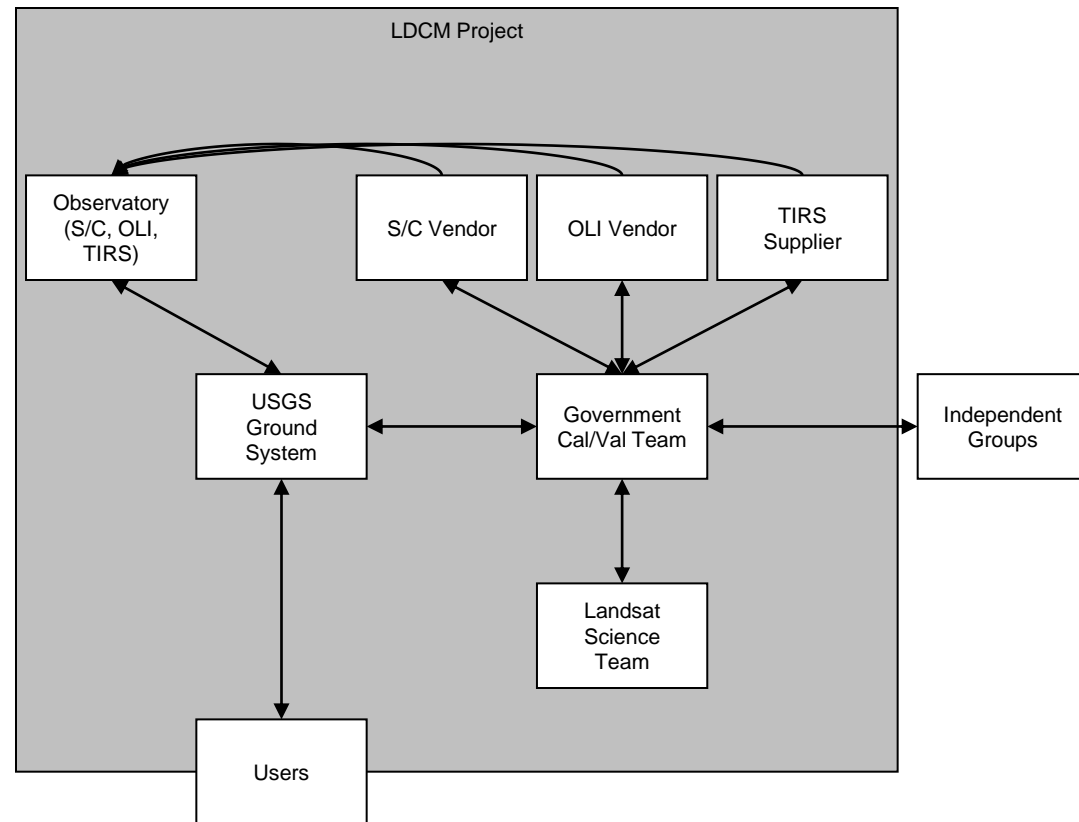


# Calibration and Validation Functions

- Instrument performance characterization
  - Pre-launch, on-orbit checkout and on-orbit operations
  - Supports instrument acceptance
- Calibration parameter determination & validation
  - Pre-commissioning validation of vendor provided parameters
  - Validated parameters ensure quality products
  - Determine parameters during operations
- Independent calibration verification and calibration continuity
  - Ensures traceability and continuity with historical products
- Product performance characterization
  - Reports for science and user community
- Anomaly resolution
  - Includes anomalies in product generation and image assessment
  - Supports observatory and other anomaly resolution

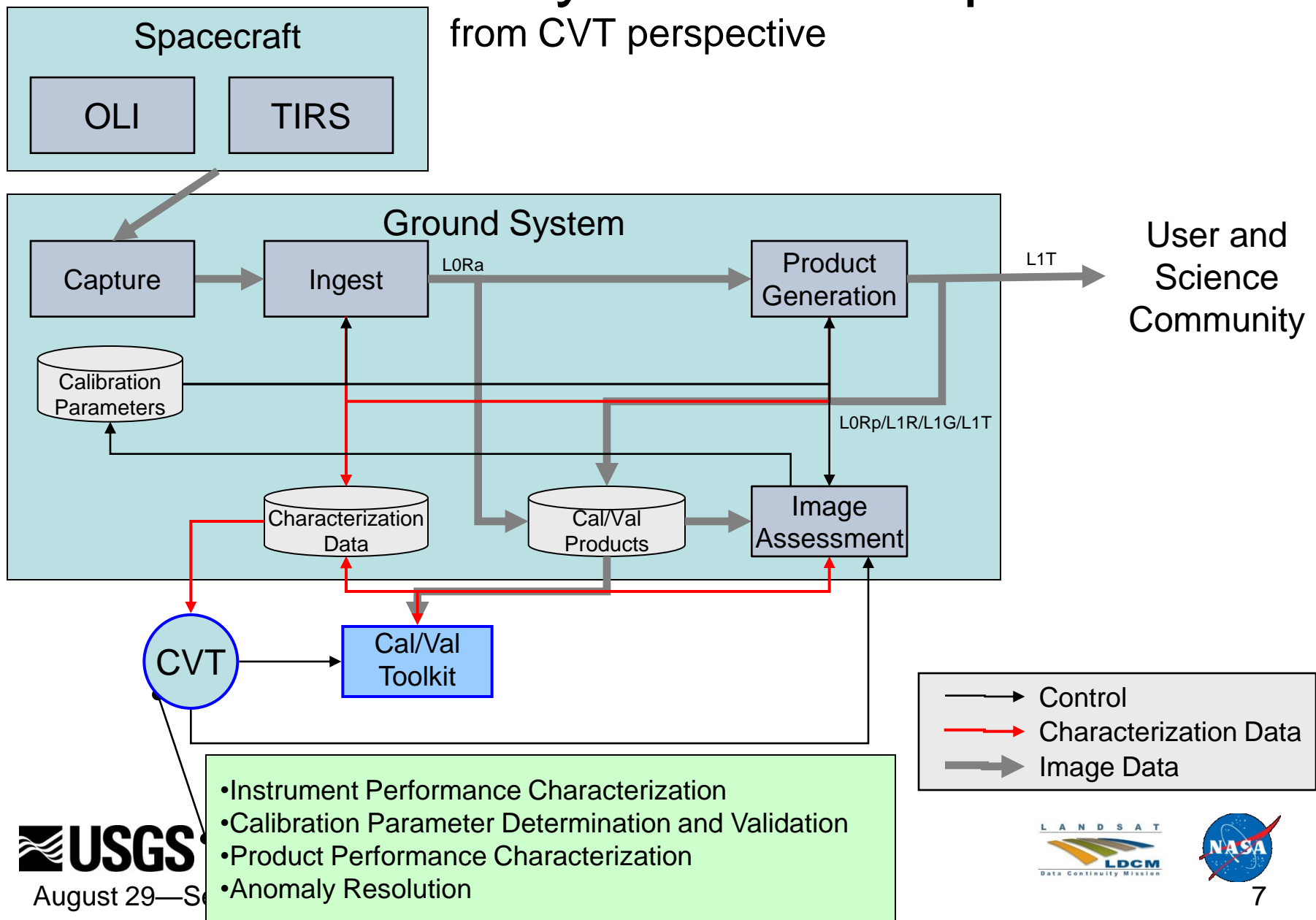
# Cal/Val Interfaces During Development

- Vendor/Supplier
  - OLI
  - TIRS
  - Spacecraft
- Ground System
  - Data Processing and Archive System
- Landsat Science Team
- Independent Groups
  - Vicarious Calibration



# Ground System Concept

from CVT perspective



# Calibration and Validation Toolkit

- **Description**

- Mixture of different languages (C, Matlab, IDL, Excel)
- Configuration controlled by CVT using Subversion
- Analyst intensive, low efficiency, non-operational code

- **Uses**

- Validate algorithms and verify ground system implementation
- Improve algorithm functionality
- Investigate processing and instrument anomalies
- Support instrument acceptance

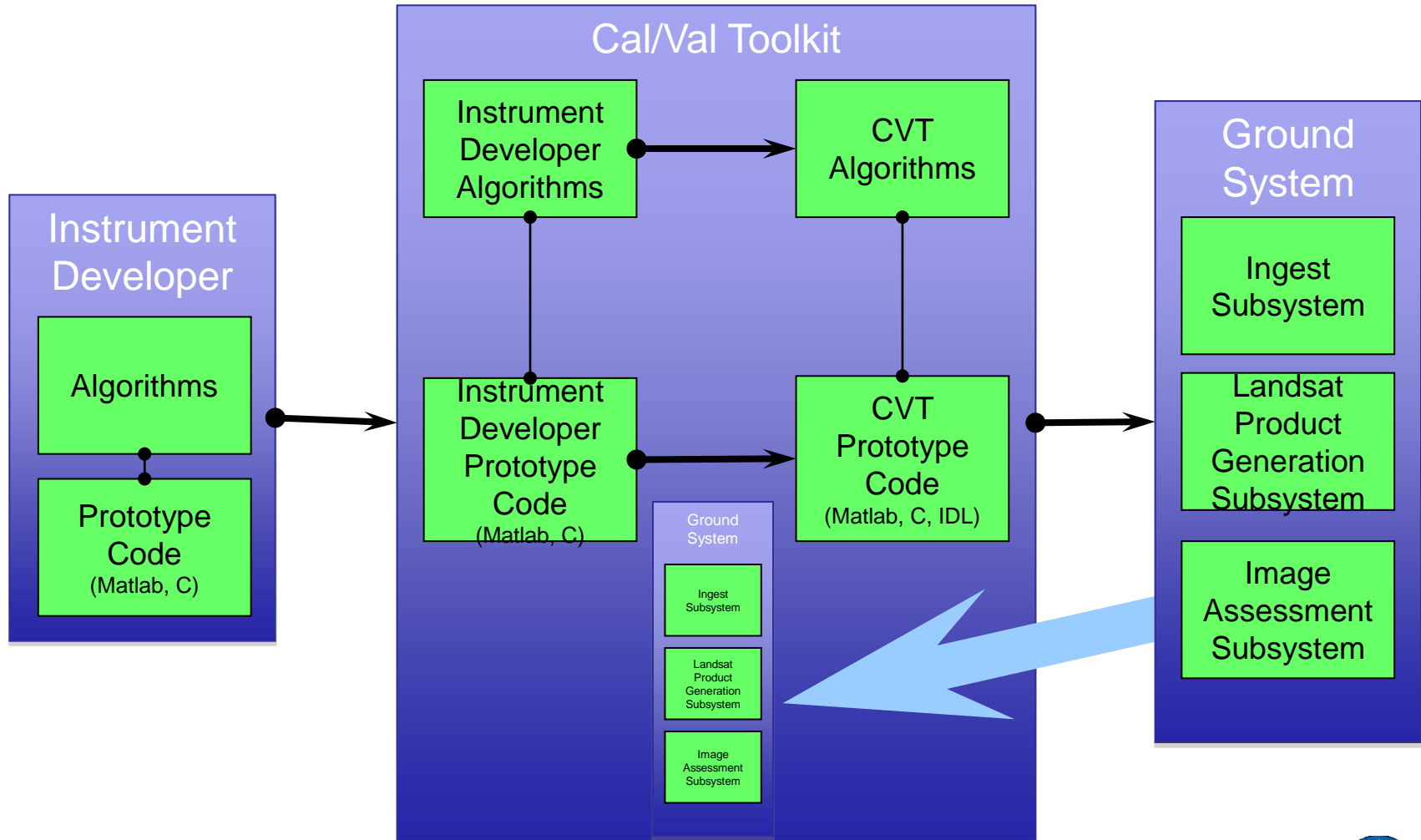
- **Contains working copies of all algorithms**

- Instrument provider algorithm baseline
- Ground system algorithm baseline (ingest, product generation, image assessment)
- Algorithm prototyping/working versions, including algorithms not implemented in the ground system





# Cal/Val Tool Development



# Phased Algorithm Development

- **Algorithm delivery synchronized with instrument and ground system major reviews**

## ☑ Phase 1

- Includes brief descriptions
- Supports ground system preliminary design

## ☑ Phase 2

- Based on preliminary provider algorithm descriptions
- Supports ground system detailed design

## ☑ Phase 3

- Based on instrument testing
- Supports ground system implementation

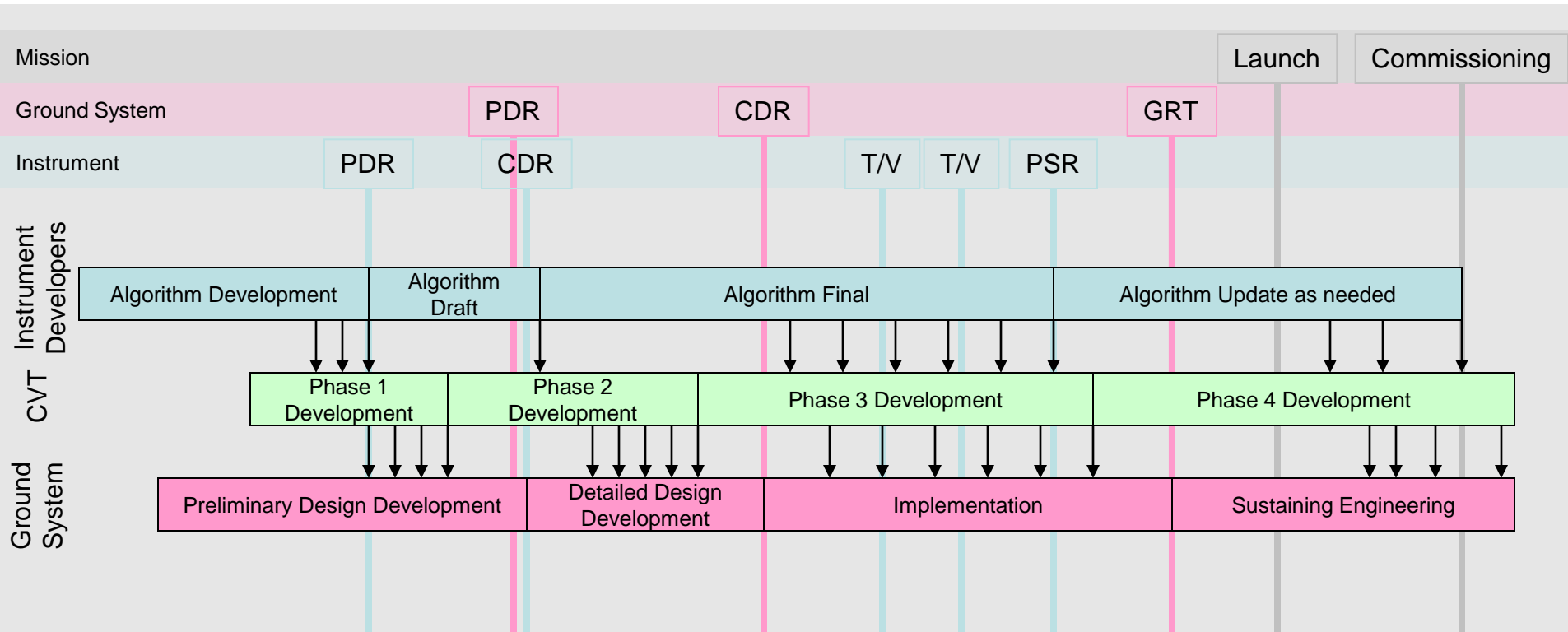
## – Phase 4

- Based on on-orbit instrument analysis
- Supports post-launch ground system update

	Alg. Delivery Phase			
Section	1.0	2.0	3.0	4.0
Background	x	x	x	x
Inputs	x	x	x	x
Outputs	x	x	x	x
Maturity	x	x	x	x
Procedure		x	x	x
Prototype			x	x
Test Data			x	x
Verification			x	x



# Relational Schedule



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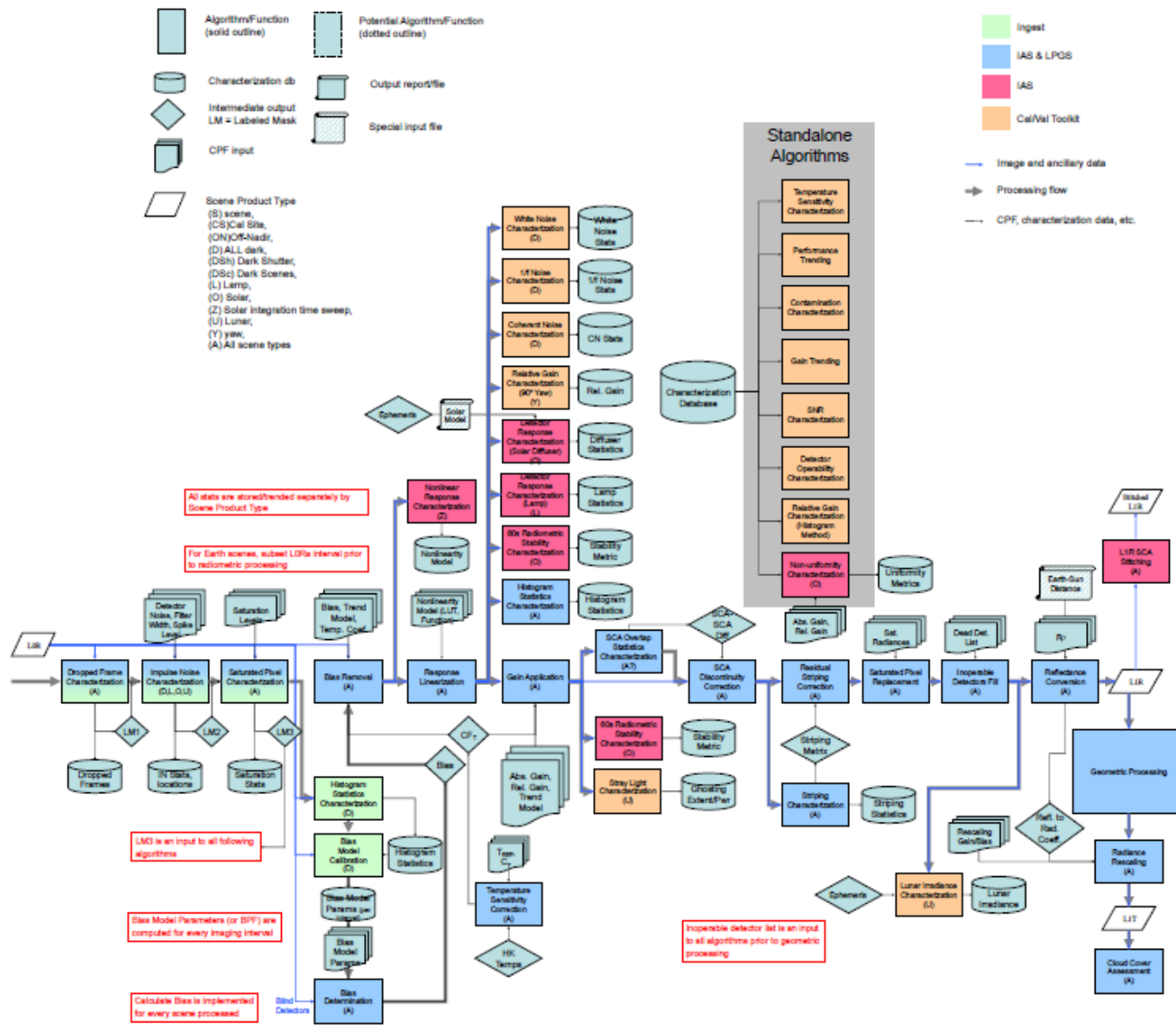
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# Current Status

- Algorithms received from instrument providers
- Algorithms delivered to ground system developers
- Initial release of image assessment subsystem completed
  - Only minor issues remain to be resolved with second release
- One more image assessment release to go
  - Lower priority algorithms
  - Changes found during testing





# In-line Characterization Algorithms

- ✓ Dropped Frame Characterization
- ✓ Impulse Noise Characterization
- ✓ Saturated Pixel Characterization
- ✓ Histogram Statistics Characterization
- ✓ SCA Overlap Statistics Characterization
- Striping Characterization



# Off-line Characterization Algorithms

- White Noise Characterization
- 1/f Noise Characterization
- Coherent Noise Characterization
- Relative Gain Characterization
  - Side Slither and Histogram Method
- ✓ Detector Response Characterization
  - Solar Diffuser and Internal Lamp
- ✓ Radiometric Stability Characterization
- Nonlinear Response Characterization
- Lunar Irradiance Characterization



# Processing Algorithms

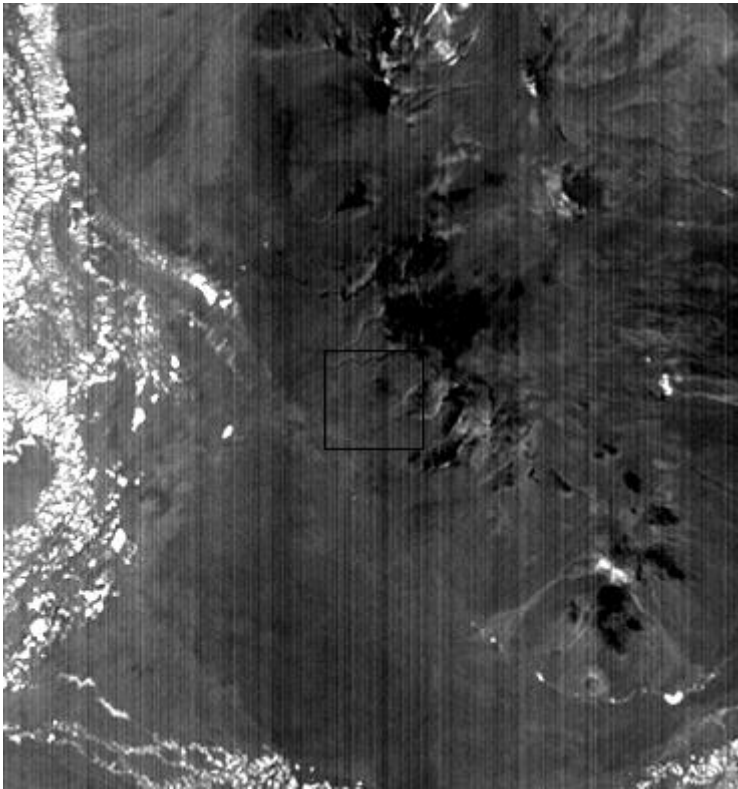
- ✓ Bias Removal
  - Bias Model Calibration
  - Bias Determination
- ✓ Response Linearization
- ✓ Gain Application
- SCA Discontinuity Correction
- Residual Striping Correction
- Saturated Pixel Replacement
- Inoperable Detectors Fill
- ✓ Reflectance Conversion



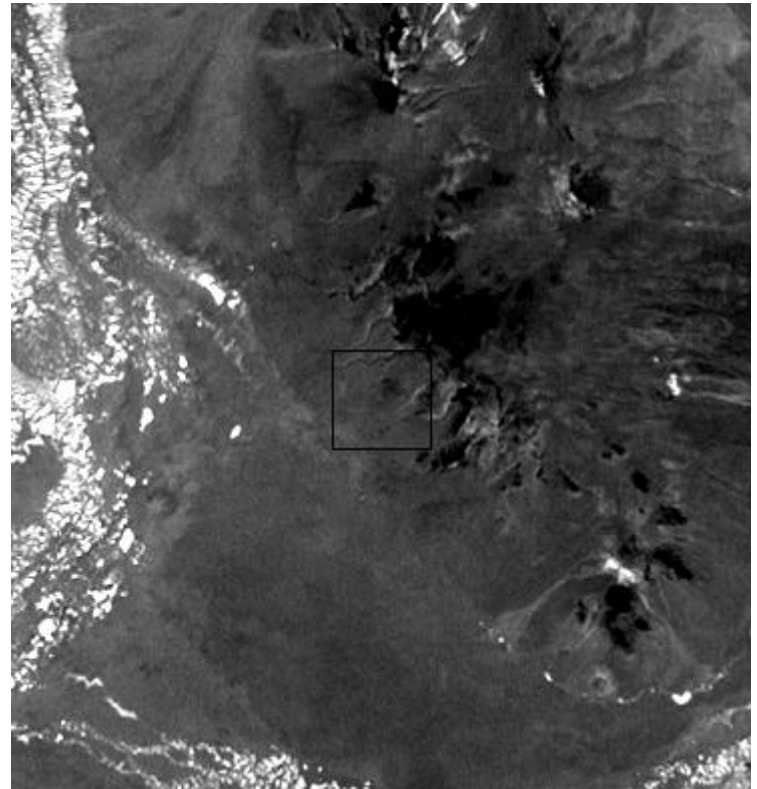


# Initial Image Assessment Subsystem

Level 0R



Level 1R



Example of radiometric processing to generate floating point Level 1R  
“product” for band 1, SCA 1